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## ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

### Procedures for Using Yield Simulation Programs for Dwarf Mistletoe-Infested Lodgepole and Ponderosa Pine Stands

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Describes procedures for application of two recently published computer programs for yield simulation of dwarf mistletoe-infested stands: LPMIST for lodgepole pine in the central Rocky Mountains and SWYLD for ponderosa pine in the Southwest.

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Procedures and computer programs for preparing yield tables in managed, dwarf mistletoe-infested stands were published recently. They apply to lodgepole pine (*Pinus contorta* Dougl.) in the central Rocky Mountains (LPMIST—Myers, Hawksworth, and Stewart 1971) and to ponderosa pine (*Pinus ponderosa* Laws.) in the Southwest (SWYLD—Myers, Hawksworth, and Lightle 1972). This Note describes certain procedures for application of the two programs. It is directed to personnel of pest detection and control programs, and to others who may not be familiar with computer programming but are interested in the use of existing, tested programs. Additional information on possible modifications of the programs, including related field work, is available elsewhere (Myers 1971).

Coefficients of the equations in the programs were computed with data from even-aged stands. Therefore, the stands to be analyzed should have an even-aged structure. In such stands, diameters of most trees will not differ greatly from average diameter of the stand, and very few of the trees will occur in the largest and smallest diameter classes. Although the range of tree diameters in an even-aged stand will increase with stand age and time since treatment, stands with a range in diameters greater than 12 inches may not be even-aged. Ages of

trees in the smaller diameter classes must then be compared with ages from the main stand.

The stand must also be relatively uniform in species composition, site quality, and past treatment, to conform to the definition of the term stand. Stands of any size may be analyzed, since the yield table gives values for an average acre. Requirements of stand uniformity will usually limit stand areas to 100 to 200 acres, and they will often be much less.

Occasional trees of slightly different age class or of different species may be present in the stand being analyzed. As a practical matter, they will be included in the stand data as though they are members of the main stand. Of course, the more such trees that occur in the area, the less accurate the yield predictions may be. The amount of variation that may exist before accuracy is reduced noticeably will depend on such things as relative growth rate of the species.

#### Field Measurements

Data on the five following stand factors are needed for the LPMIST or SWYLD programs. The definitions of these variables given below describe the initial values obtained from field measurements, as entered by the data deck.

1. AGE0. Mean stand age at time of first thinning to be shown in the tables, based on live trees of the dominant and codominant crown classes. AGE0 may be that of the first

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computed partial cut or, with suitable program modification (Myers 1971), may be the age at time of an actual cut in a real stand.

2. DBHO. Mean d.b.h. of trees in the stand at age AGE0, based on live trees of all crown classes. DBHO should be determined to the nearest 0.1 inch. Mean d.b.h. is the diameter of the tree of mean basal area.

3. DENO. Stand density—the number of live trees per acre of all crown classes at age AGE0.

4. SITE. Site index of the stand based on mean height of dominant and codominant trees at a base age of 100 years. For lodgepole pine, determine site index with corrections for stand density as measured by the crown competition factor (CCF) (Alexander 1966). For ponderosa pine, tables published by Meyer (1938) are appropriate.

5. START. The age of the stand when dwarf mistletoe infection began. It is an overall figure indicating the mean age when infection began at various points throughout the stand. It is not merely the age when earliest infection occurred.

Shortcut methods are available for estimating START in stands under 100 years old when either the mean mistletoe rating of the stand (6-class system, fig. 1) or proportion of trees infected is known. Estimates based on average stand mistletoe ratings are believed to be most accurate and should be used whenever possible.

The length of time that dwarf mistletoe has been in a stand can be estimated from average

stand mistletoe ratings from the following tabulation. For example, ponderosa pine stands with an average infection rating of 3.0 have been infected for 30 years. This period is then deducted from present stand age to determine mean stand age when infection began (START).

| Stand dwarf<br>mistletoe<br>rating | Length of time infected<br>(Years) |                   |
|------------------------------------|------------------------------------|-------------------|
|                                    | Ponderosa<br>pine                  | Lodgepole<br>pine |
| 0                                  | 0                                  | 0                 |
| 0.5                                | 8                                  | 9                 |
| 1.0                                | 14                                 | 15                |
| 1.5                                | 18                                 | 21                |
| 2.0                                | 22                                 | 27                |
| 2.5                                | 26                                 | 32                |
| 3.0                                | 30                                 | 37                |
| 3.5                                | 35                                 | 44                |
| 4.0                                | 40                                 | 51                |
| 4.5                                | 47                                 | 59                |
| 5.0                                | 57                                 | 68                |
| 5.5                                | 70                                 | 80                |
| 6.0                                | 88                                 | 98                |

An alternate method of estimating length of time that dwarf mistletoe has been present in a stand is based on the proportion of trees infected. The following tabulation applies to both lodgepole pine and ponderosa pine. For example, if 75 percent of the trees in a stand are infected, the approximate time that the stand has been infected is 25 years. This period is then deducted from present stand age to estimate START.

## MISTLETOE RATING SYSTEM

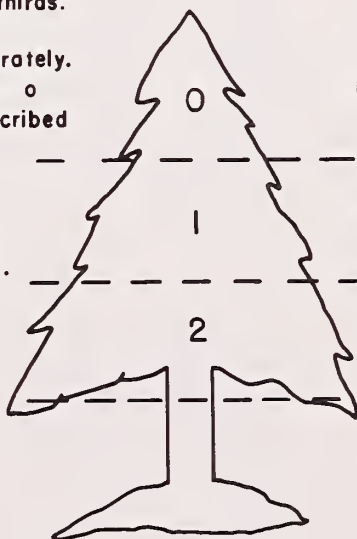
### INSTRUCTIONS

STEP 1. Divide live crown into thirds.

STEP 2. Rate each third separately. Each third should be given a rating of 0, 1 or 2 as described below.

- (0) No visible infections.
- (1) Light infection (1/2 or less of total number of branches in the third infected).
- (2) Heavy infection (more than 1/2 of total number of branches in the third infected).

STEP 3. Finally, add ratings of thirds to obtain rating for total tree.



### EXAMPLE

If this third has no visible infections, its rating is (0).

If this third is lightly infected, its rating is (1).

If this third is heavily infected, its rating is (2).

The tree in this example will receive a rating of  $0 + 1 + 2 = 3$ .

Figure 1.--

Instructions for and example of the use of the 6-class mistletoe rating system (Hawksworth 1961).

| Trees<br>infected<br>(Percent) | Length<br>of time<br>infected<br>(Years) | Trees<br>infected<br>(Percent) | Length<br>of time<br>infected<br>(Years) |
|--------------------------------|--|--------------------------------|--|
| 0                              | 0  | 60                             | 19                                       |
| 5                              | 4  | 65                             | 20                                       |
| 10                             | 7  | 70                             | 22                                       |
| 15                             | 9  | 75                             | 25                                       |
| 20                             | 10                                       | 80                             | 28                                       |
| 25                             | 11                                       | 85                             | 32                                       |
| 30                             | 12                                       | 90                             | 36                                       |
| 35                             | 13                                       | 92                             | 39                                       |
| 40                             | 14                                       | 94                             | 42                                       |
| 45                             | 15                                       | 96                             | 46                                       |
| 50                             | 16                                       | 98                             | 52                                       |
| 55                             | 17                                       | 100                            | 70                                       |

### Management Decisions

In addition to the field measurements, several management decisions must be made for the stand to be analyzed. Items 1 through 4, below, are needed for the LPMIST program; items 1 through 3 and 5 through 11 for SWYLD.

1. THIN. The growing stock level to which the stand is to be reduced in the first thinning. Growing stock levels for both ponderosa and lodgepole pines are designated by the square feet of basal area desired when average stand d.b.h. is 10 inches or more (Myers 1971). Basal area in a stand of smaller average d.b.h. is less than the designated level as shown in figure 2 and table 1. For example, if a growing stock level of 80 is desired and the stand will have an average d.b.h. after thinning of 6.0 inches, the actual basal area to be retained is 56.6 square feet. If a growing stock level of 100 is desired,  $(100/80) \times 56.6$ , or 70.8 square feet will be left. Table 1 can also be used to calculate

the appropriate growing stock level if it is desired to leave a certain residual basal area on the ground. For example, if it is desired to leave 71 square feet of basal area in a stand 6.0 inches in diameter, the growing stock level to be entered in the program would be 100. The computation is:

$$\begin{aligned} \text{LEVEL}/80 \times 56.6 &= 71 \\ \text{LEVEL} &= 100 \end{aligned}$$

In both examples, level is divided by 80 because table 1, source of the known basal area values, is for growing stock level 80.

2. DSTY. The growing stock level to which the stand is to be reduced in subsequent thinnings. The programs will compute and print as many yield tables as desired. The first table will have as subsequent level the value of DSTY. Each following table will have a growing stock level, as defined above, 10 higher than that of the previous table computed.

3. JCYCL. The interval between intermediate thinnings. JCYCL must be in multiples of 10 years.

4. ROTA. The rotation age or age at harvest cutting, if LPMIST is used without modification. The following seven items replace ROTA for SWYLD.

5. REGN(1). Stand age at first regeneration cut. Must never be zero or blank, as this is rotation length for clearcutting.

6. VLLV(1). Percentage of previous growing stock level to be left at age REGN(1). Will be zero with clearcutting. Enter as a decimal.

7. INVL(1). New interval between cuts in effect after age REGN(1). Will be zero with clearcutting.

8. REGN(2). Stand age at which second regeneration cut, if any, will occur. Removal of seed trees or second cut of shelterwood.

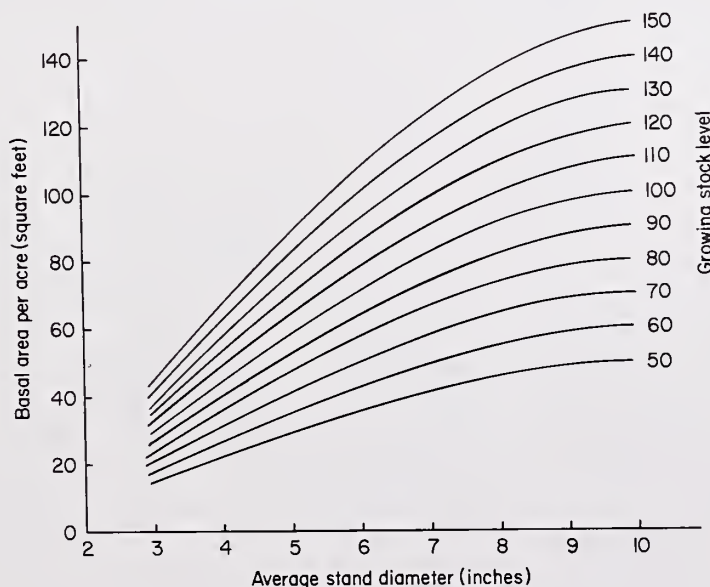


Figure 2.--  
Basal area after  
thinning in  
relation to  
average stand  
diameter for  
standard levels  
of growing stock.



Table 1.--Basal areas after intermediate cutting in relation to average stand diameter  
growing stock level 80

| Average<br>stand d.b.h.<br>after cutting<br>(Inches) | Basal<br>area<br>per<br>acre | Average<br>stand d.b.h.<br>after cutting<br>(Inches) | Basal<br>area<br>per<br>acre | Average<br>stand d.b.h.<br>after cutting<br>(Inches) | Basal<br>area<br>per<br>acre | Average<br>stand d.b.h.<br>after cutting<br>(Inches) | Basal<br>area<br>per<br>acre |
|--|------------------------------|--|------------------------------|--|------------------------------|--|------------------------------|
|  | <u>Sq. ft.</u>               |  | <u>Sq. ft.</u>               |  | <u>Sq. ft.</u>               |  | <u>Sq. ft.</u>               |
| 2.0  | 12.1                         | 4.0  | 35.2                         | 6.0  | 56.6                         | 8.0  | 72.5                         |
| 2.1  | 13.2                         | 4.1  | 36.4                         | 6.1  | 57.6                         | 8.1  | 73.1                         |
| 2.2  | 14.4                         | 4.2  | 37.6                         | 6.2  | 58.5                         | 8.2  | 73.7                         |
| 2.3  | 15.5                         | 4.3  | 38.7                         | 6.3  | 59.4                         | 8.3  | 74.3                         |
| 2.4  | 16.7                         | 4.4  | 39.9                         | 6.4  | 60.3                         | 8.4  | 74.8                         |
| 2.5  | 17.9                         | 4.5  | 41.0                         | 6.5  | 61.2                         | 8.5  | 75.3                         |
| 2.6  | 19.0                         | 4.6  | 42.2                         | 6.6  | 62.1                         | 8.6  | 75.8                         |
| 2.7  | 20.2                         | 4.7  | 43.4                         | 6.7  | 62.9                         | 8.7  | 76.3                         |
| 2.8  | 21.3                         | 4.8  | 44.5                         | 6.8  | 63.8                         | 8.8  | 76.7                         |
| 2.9  | 22.5                         | 4.9  | 45.7                         | 6.9  | 64.6                         | 8.9  | 77.1                         |
| 3.0  | 23.7                         | 5.0  | 46.8                         | 7.0  | 65.4                         | 9.0  | 77.5                         |
| 3.1  | 24.8                         | 5.1  | 47.8                         | 7.1  | 66.2                         | 9.1  | 77.9                         |
| 3.2  | 26.0                         | 5.2  | 48.8                         | 7.2  | 67.0                         | 9.2  | 78.2                         |
| 3.3  | 27.1                         | 5.3  | 49.8                         | 7.3  | 67.7                         | 9.3  | 78.5                         |
| 3.4  | 28.3                         | 5.4  | 50.8                         | 7.4  | 68.5                         | 9.4  | 78.8                         |
| 3.5  | 29.5                         | 5.5  | 51.8                         | 7.5  | 69.2                         | 9.5  | 79.1                         |
| 3.6  | 30.6                         | 5.6  | 52.8                         | 7.6  | 69.9                         | 9.6  | 79.3                         |
| 3.7  | 31.8                         | 5.7  | 53.8                         | 7.7  | 70.6                         | 9.7  | 79.5                         |
| 3.8  | 32.9                         | 5.8  | 54.7                         | 7.8  | 71.2                         | 9.8  | 79.7                         |
| 3.9  | 34.1                         | 5.9  | 55.7                         | 7.9  | 71.9                         | 9.9  | 79.8                         |
|  |                              |  |                              |  |                              | 10.0+  | 80.0                         |

9. VLLV(2). Percentage of previous growing stock level, including effect of VLLV(1), to be left at age REGN(2). May be zero. Enter as a decimal.

10. INVL(2). New interval between cuts in effect after age REGN(2). May be zero.

11. REGN(3). Stand age at which third regeneration cut, if any, will occur. Final cut of 3-cut shelterwood.

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